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Do better institutions improve bank efficiency? Evidence from a transitional economy

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Iftekhar Hasan*, Haizhi Wang** and Mingming Zhou***

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Abstract

The pace of transition in China over the last two decades has led to great variation across the country in terms of institutional and financial development. In this paper, using a panel of Chinese provinces during the period 1993–2006, we empirically investigate the determinants of the efficiency of the banking sector from an institutional perspective. The most important institutional developments in China are the emergence and gradual dominance of the market economy, financial deepening, the growth of a private sector, the establishment of secure property rights, and rule of law. We find that institutional variables play an important role in affecting banking efficiencies, and that banks tend to operate more efficiently in those regions with a greater private sector presence and more property rights awareness, while the role of financial deepening and rule of law is less straightforward.

JEL classifications: G21, O43
Keywords: Institutional development, Bank efficiency, Chinese banks

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Tiivistelmä

Kiinan järjestelmämuutos viimeisen kahden vuosikymmenen aikana on johtanut suuriin alueellisiin eroihin institutionaalisessa ja rahoitussektorin kehityksessä. Tässä keskustelualoitteessa tutkitaan Kiinan provinsseja koskevaa vuosien 1993–2006 ns. paneelidataa käyttäen pankkisektorin tehokkuuteen vaikuttavia tekijöitä instituutioiden näkökulmasta. Tärkeimpiä institutionaalisia kehityskaskelia Kiinassa ovat olleet markkinatalouden periaatteiden painoarvon selvä kasvu, rahoitussektorin ja yksityisen sektorin kasvu, omistusoikeuden periaatteiden hyväksyminen sekä laillisuusperiaatteen aiempaa yleisempi noudattaminen. Tulosten mukaan institutionaaliset tekijät vaikuttavat selvästi pankkien tehokkuuteen. Pankit ovat tehokkaampia provinsseissa, joissa yksityisen sektorin osuus taloudesta on suuri ja joissa omaisuudensuoja on varmempi. Rahoitussektorin koon ja laillisuusperiaatteen vaikutus tehokkuuteen ei ole yksiselitteinen.

Asiasanat: institutionaalinen kehitys, pankkien tehokkuus, Kiinan pankkijärjestelmä

1 Introduction

In most economies around the world, banks, as dominant suppliers of external finance, play an important role in channeling capital from savings to investment (Demirguc-Kunt and Levine, 2001). The role of banks in economic growth has been well established in the existing literature, starting with studies of King and Levine (1993a, 1993b, 1993c). However, the conventional measure of the role of banking institutions in the economy has been focused on the quantitative side, such as the ratio between the liquid liabilities of the banking system and GDP (Gertler and Rose, 1994; King and Levine, 1993b, 1993c), the ratio of domestic credit to GDP (Rajan and Zingales, 1998), and the share of credit granted to the private sector in ratio to GDP (King and Levine, 1993a, 1993b; Levine, 1998, 1999; Beck et al., 2000; Wurgler, 2000). The quantitative measures of banking presence have shortcomings in the sense that they essentially concentrate on the role of banks in stimulating capital accumulation.

As the literature has shown, the specific role performed by banks in the economic system is not to intermediate savings, but rather to certify the quality of borrowers and increase their probability of successful innovation to enhance productivity, and to monetize liabilities which otherwise would fail to find purchasers in the markets (Fama, 1985; Minsky, 1986; Moore, 1988; Stiglitz and Weiss, 1988; Lucchetti, Papi, and Zazzaro, 2001). Therefore, banking efficiency, which measures the relative ability of banks to efficiently utilize their resources to generate outputs, is a better measure because it captures the quality of banking institutions and their function in the economy.

Studies of banking efficiency are abundant, and they yield important implications for financial institutions in areas of government policy, research, and managerial performance (see survey by Berger and Humphrey, 1997). However, the existing literature that attempts to explain the determinants of banking efficiency primarily focuses on a number of banks, markets, and regulatory characteristics. While recent literature emphasizes the role of institutions in explaining economic transitions and growth (Henisz, 2000), institutional factors as potential sources of determinants of banking efficiency have largely been ignored (see the survey by Berger and Mester, 1997).

An institutional setting, constituting both formal and informal rules and their enforcement, is what defines the incentives and wealth-maximizing opportunities of both individuals and organizations. Aron (2000) argues that institutions affect growth because

they influence the costs of transactions and the efficiency of production. Consequently, the institutional environment may well affect the way in which banks conduct business, and their rate of efficiency. Law and finance literature, pioneered by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997, 1998; LLSV hereafter), document that some environments are more conducive to designing and enforcing financial contracts than others, and that better contracting leads to better outcomes. For example, Berger and Udell (2006) suggest that elements of the legal/institutional infrastructure may have important effects on the abilities of banks to use "hard" information lending technologies to extend credits to SMEs. A recent study by Qian and Strahan (2007), document that strong creditor rights seem to enhance loan availability as lenders are more willing to provide credit on favorable terms.

Furthermore, some studies substantiate the importance of other aspects of the institutional setting for bank practices. For example, Bolton and Scharfstein (1996) argue that the optimal concentration of creditors reflects the trade-off of inefficient renegotiation following default against borrowers' incentive to default strategically. Demirguc-Kunt, Laeven, and Levine (2003) document that rigid regulations on bank entry and bank activities will lead to an increase of the cost of financial intermediations.

In a standard cross-country setting, banks' ability to force repayment and their costs of enforcing contracts can be measured by legal and institutional variables. However, it is very difficult to observe and control for the set of social, cultural, and relationship variables that potentially play an important role in affecting financial intermediation across a large number of countries. In this paper, we examine the role of institutions in explaining banking efficiencies, using provincial data in China, which is one of the largest and fastest growing transitional and emerging economies in the world. In using the sub-national level data, we are able to focus on specific aspects of the institutional and political system while largely avoiding the data comparability issue common in most cross-nation studies.

The late twentieth century witnessed the transformation of numerous centrally planned economies around the world into market systems. Instead of making the transition through a "Big Bang" (Hoff and Stiglitz, 2004), China has followed an incremental and experimental approach to reform that has resulted in high and stable growth rates for over three decades (Prasad and Rajan, 2006). Amid the miracles of the Chinese economy's high growth rates, the role of the banking sector, despite its predominant size, is inconclusive in

the existing literature (see, Hasan, Wachtel, Zhou, 2008). The Chinese banking sector has been dominated by four very large state-owned banks – the "Big Four" – with about three-fourths of banking assets. Given the size of the banking sector in China, the level of inefficiency of Chinese banks found by the existing literature (e.g., Berger, Hasan and Zhou, 2008), and the implications of banking efficiency for financial stability, firm growth, and the macro economy as we discussed earlier, it would be interesting to examine the potential determinants of the banking efficiencies in China. Our paper answers this question by looking at the institutional environment in which the banks operate.

In this paper, we measure the efficiency of the banking sector for a region as a function (i.e., weighted average) of the efficiency of the banks that operate in that region. We then exploit the regional differences in the timing and extent of the development of legal and political institutions to demonstrate the impact on banking efficiency. Our results show that different institutional factors tend to have different effects on the efficiency of the banking sector. To be specific, a higher degree of financial deepening in the banking sector is found to be positively related to profit efficiency, but negatively related to cost efficiency. Our results indicate that the presence of the private sector is positively and significantly correlated to both the profit and cost efficiency of the banking sector in a certain region. We also find that our proxy for awareness of property rights is positively and significantly correlated to both the profit and cost efficiency of the banks. Moreover, we document that the rule of law is negatively associated with banking profit efficiency, but positively associated with banking cost efficiency. In sum, our empirical results indicate that banks tend to operate more efficiently in those regions with a greater private sector presence, and more property rights awareness, while the role of financial deepening and rule of law is less straightforward.

The rest of this paper is organized as follows. Section 2 provides some background information on the institutional environment, reforms in China, and related research. Section 3 describes our data and the various measures we employ for institutional development. In Section 4, we present our empirical results relating bank efficiency measures to the institutional environment. Section 5 summarizes and concludes the discussion/analysis.

2 Institutions and banking in China and related literature

2.1 Institutions in China

While China has maintained a fast pace in economic growth as a whole, it exhibits substantial regional differences as well. For example, Aziz and Duenwald (2001) show that the variation in China's economic performance has displayed some distinct geographical patterns. In addition, the provincial data reveals significant variation in relative economic performance over time (Demurger *et al*., 2002). Meanwhile, the transition from planned to market economy in China necessitates the establishment of an almost entirely new set of institutions, and the development of institutions is not evenly distributed across different regions. As we have argued, differences in regional institutional development may affect the efficiency of the local banking system. In order to place our study in the institutional context in China, we provide a description of relevant institutional reforms in China over the last two decades.

Credit markets in China play a major role in channeling capital from saving to investment. However, the capital allocation to the private sector only comprises a small portion of GDP, compared to other developed countries. It was not until the early 1990s that the central government started to reform the financial system by separating policy banks from commercial banks. In the subsequent years, a series of steps were taken to transform urban credit unions into commercial banks (1996-1998), grant limited licenses to non-state commercial banks and foreign banks, and introduce standard accounting and prudential norms. Many additional changes were introduced after China's entry into the WTO in 2001, including the liberalization of interest rates, and the relaxation of restrictions on ownership. Recently, the Chinese government took cautious actions to partially privatize its banks by selling shares to both domestic and foreign investors, who, in the latter case, can hold minority equity stakes (see, Berger *et al*., 2008).

The establishment of the Shanghai Stock Exchange in 1990 and the Shenzhen Stock Exchange in 1991 was initially aimed at promoting the reform of state-owned enterprises (SOEs). Hence, financially stressed SOEs can obtain direct equity financing through both initial public offerings and seasoned equity offerings in the markets. Though listing the SOEs as publicly traded companies, the government still holds controlling stakes. In

order to pursue better corporate governance, the equity division reform was promoted in the past two years.

Corporate bond markets lagged behind the development of the equity market. Although bonds were first issued in 1986, outstanding corporate bond issues in 1999 were only about one-half of one percent of GDP (*People's Daily*, Sept. 1, 2000). The corporate bond market began to expand after 2000 when new rules governing issuance were implemented. Besides the giant SOEs, local firms were also encouraged to issue corporate bonds.

The emergence of a prosperous private sector, which now accounts for approximately a third of GDP (IFC, 2000), has been a major outcome of the market-oriented reform in China. Small private firms were first formed in rural areas, and not officially recognized until 1988. In the 1990s, privatization was introduced to revitalize SOEs. In 1999, a constitutional amendment formalized the recognition of the private sector. Despite the contributions of the private sector to the economy, private firms, especially those without state-owned equity stakes, have limited access to bank credits and stock markets, and thus have to rely heavily on informal financial channels and self-financing.

The development of the modern Chinese legal system started after the Cultural Revolution, and became a government priority in the 1990s. Numerous laws, regulations and administrative rules have been enacted since 1979, including new legislation regarding the regulation of securities markets, consumer protection, intellectual property, and banking and insurance. Accordingly, institutions to enforce the rules have also been established.

As part of its economic and legal reforms, the government adopted a law to protect foreign patents in 1984. In the late 1980s, regulations went into effect that enabled enterprises to define property rights and separate collective and private enterprise shares. The 1994 Company Law improved property rights by establishing the firm as a legal entity. It is noteworthy that laws regarding property rights were locally enacted, following national legislation, and thus the strength of legal enforcement differed across regions (Krug and Hendrischke, 2003).

This brief summary of major changes in the economic environment and institutions in China points out two important issues. First, the reform process has already touched on a broad range of economic, political, and social institutions. Second, reforms are often locally based, and thus there is variation across the country and over time in insti-

tutional development. In this paper, we explore these regional differences over time, and investigate whether and to what extent these institutional differences affect bank efficiency.

2.2 Banking industry in China

In this section, we briefly discuss the institutional history, regulation, and economic environment of the Chinese banking system. This system has continuously undergone significant changes due to policy shifts over the last twenty years.

The Chinese socialist banking system was established in the late 1940s, following the system in the former Soviet Union. The central bank, the People's Bank of China (PBOC), founded in 1948, was stripped of many of its central bank functions during the Cultural Revolution (1966-1976), but later regained responsibility for currency issue[for issuing currency] and monetary control. Before 1978, the Chinese system followed a mono-bank model in the sense that the PBOC assumed the roles of both central and commercial banking. Other banks were either taken over or restructured into the PBOC system. The banking system expanded by establishing several large state-owned commercial banks which took the lending functions from the PBOC. The Bank of China (BOC, established 1912), China Construction Bank (CCB, 1954), Agricultural Bank of China (ABC, 1979), and Industrial and Commercial Bank of China (ICBC, 1984) were initially limited to serve only their designated sector of the economy (i.e., foreign trade and exchange; construction; agriculture; industrial and commercial lending). In 1985, the Big Four were allowed to compete in all sectors. Nonetheless, competition among them was very limited until the mid-1990s because they served mainly as policy-lending "conduits" for the government, and lacked incentives to compete.

Because the majority of bank loans made by the Big Four went to SOEs, the asset quality of state-owned banks deteriorated significantly during the 1990s. The government established three policy banks in 1994 to take over the policy-lending activities, and issued special, 30-year government bonds totaling 270 billion RMB (US $32.6 billion) in order to recapitalize the Big Four banks in 1998.

Although there is no explicit deposit insurance, implicit deposit insurance is in place in the sense that the Chinese government has almost always intervened in case of bank failure. However, things began to change in 1999 when Guangdong International

Trust and Investment Corporation were unable to repay outstanding debt in amounts exceeding US $5 billion. The central government did not assume the main repayment responsibilities as creditors expected, and debt-holders finally collected an average of 12.54% back from their original investment.[1]

In 1995, two major legislative reforms occurred. The Central Bank Law of China went into effect to establish the PBOC as the central bank and substantially reduced the influence of local governments on credit allocation decisions. In addition, the Commercial Bank Law of China of 1995, officially termed the major objective of state-owned banks, was allowed to operate as a commercial bank according to market principles instead of policy lending. At the same time, *de novo* banks were allowed to enter the market in the mid-1990s.

China became a member of the WTO in 2001. Since then, a new set of regulations as well as revisions of existing rules were established in line with the WTO agreement. In order to achieve better monitoring of the banking industry, the China Banking Regulatory Commission (CBRC) was set up in 2003 to oversee reforms and regulations. In 2003, the CBRC updated its guidelines to encourage foreign investors to purchase shares in domestic banks. As a result, foreigners can own up to 25% of any domestic bank, with the ownership by any one investor allowed between 5% and 20%, subject to regulatory approval. Strategic foreign investments have been induced first in some regional banks (e.g., Citigroup's purchase of about 5% of Shanghai Pudong Development Bank in January 2003). Since 2003, national banks, including three of the Big Four banks, have had strategic foreign investors holding minority equity stakes. Another trend in the privatization of Chinese banks is the encouragement by regulators to go public on domestic and/or foreign stock exchanges.

2.3 Related research

It is well recognized that financial sector development is very important to economic growth (King and Levine, 1993a, 1993b, 1993c). As financial intermediations, banks play a crucial role in allocating scare resource (i.e. financial capital) in the economy. A well-

[1] There are signs that the Chinese regulators are moving toward formal deposit insurance. A "deposit insurance office" was established within the Financial Stability Bureau of the PBOC in 2005. It is also reported that the China Banking Regulatory Commission is working on plans to introduce a system like the U.S. Federal Deposit Insurance Corporation.

functioned banking system can largely promote economic growth by identifying the most promising entrepreneurs and increasing their probability of successful innovation to enhance the productivity. Moreover, the existing literature has shown that the specific role performed by banks in the economic system is to certify the quality of borrowers and increase their probability of successful innovation-enhancing productivity, and to monetize liabilities which otherwise would fail to find purchasers in the markets (Fama, 1985; Minsky, 1986; Moore, 1988; Stiglitz and Weiss, 1988; King and Levine, 1993a; Lucchetti, Papi, and Zazzaro, 2001). Banks are essential for economic development in that they are a crucial device for the selection of entrepreneurs and the allocation of financial and real resources (Diamond, 1984). In this sense, banking efficiency, which measures the relative ability of banks to efficiently utilize their resources to generate outputs, is a better measure in capturing the quality of banking institutions and their functions in the economy. Indeed, over recent years, the concept of frontier efficiency has been well applied and documented in the banking literature. Berger and Humphrey (1997) provide a comprehensive survey of 130 studies that apply frontier efficiency analysis to financial institutions in 21 countries, and as discussed, the efficiency studies yield important implications for financial institutions in areas of government policy, research, and managerial performance. However, the existing literature which attempts to explain the determinants of banking efficiency primarily focuses on a number of banks, markets, and regulatory characteristics (see the survey by Berger and Mester, 1997), while leaving institutional factors as potential determinants of banking efficiency largely ignored.

Meanwhile, prior studies have emphasized the important role of institutions in promoting the economy. An appropriate institutional setting eases the transaction, reshapes the incentives of different agents, and affects the efficiency of production. LLSV (1997, 1998), among others, document that stronger investor protection and more efficient institutions are correlated with better financial and economic outcomes. However, time-series evidence on financial development challenges some of the correlations documented by LLSV (e.g., Rajan and Zingales, 2003). Demirguc-Kunt and Huizinga (1999) document that the institutional environment can also affect commercial banks' interest margins and profits. Based on a sample of loans in 43 countries, Qian and Strahan (2007) empirically investigate how financial contracts respond to the legal and institutional environment, and consistent with the law and finance view of LLSV, find that strong creditor rights seem

to enhance loan availability as lenders are more willing to provide credit on favorable terms.

Moreover, well-defined property rights are cornerstones of private sector development and growth. The protection of property rights facilitates the development of financial markets. Well-functioning and flexible financial markets allow entrepreneurs to embrace economic opportunities and promote growth by protecting entrepreneurs from being expropriated by large market participants. Aron (2000) argues that institutions are often weak in developing countries because the rules that ensure the use and trading of property rights are absent or poorly enforced. An empirical study of transition countries by Johnson et al. (2002) examines the relative importance of property rights and external finance, and finds property rights to be overwhelmingly important.

A few studies have examined the role of institutional factors in firm-level activities in China. For example, Cull and Xu (2005) use firm-level data and show that expropriation risk, contract enforcement, access to finance, and ownership structure all appear to matter for Chinese firms' reinvestment decisions. Using data on Chinese entrepreneurs, Djankov et al. (2006) highlighted the importance of legal and economic institutions in fostering entrepreneurship.

Some other studies employ province-level data to examine financial sector development and economic performance in China. For example, Biggeri (2003) uses provincial level data for the period 1986 to 2001 and finds that the level of aggregate output in each province is negatively influenced by the presence of state-owned enterprises. Liang (2005) and Hao (2006) present evidence that financial depth and the reduced role of government influence provincial growth rates. Zhang, Wan, and Jin (2007) provide evidence of financial depth effects on productivity growth with provincial panel data. More recently, Hasan et al. (2008) examine the effect of financial deepening and institutions on economic growth, and find that legal and political institutions play an important role in spurring economic growth in China.

Another line of research specifically examines Chinese bank efficiency and reform, and generates mixed results. For example, Chen et al. (2005) compare the cost efficiency of the Big Four banks and two smaller size classes of majority state-owned joint-equity banks over the period 1993-2000, and find that the Big Four and smaller joint-equity banks are both cost- efficient relative to the medium-sized joint-equity banks. However, some studies using an input distance function approach obtain contrary results

(e.g., Kumbhakar and Wang, 2005; Fu and Heffernan, 2006). Berger et al. (2008) investigate the impact of ownership on bank efficiency and find that both a foreign majority and foreign minority ownership play a big role in improving the efficiency of Chinese banks.

However, to the best of our knowledge, there are very few studies investigating how different institutional factors affect bank efficiency from an institutional perspective. As we discussed earlier, the economic performance of China's economy exhibits great geographic variation, and so does the development of the financial and institutional environment. China provides an ideal laboratory for exploring how the different paces of institutional development may impact the banking sector's efficiency. Building on the existing literature, our study attempts to fill the gap in the literature by investigating whether and how the variation in regional institutional settings, including both financial and legal institutions, may affect the efficiency of the banking sector in China.

3 Data collection and sample description

In this section, we report our data collection procedure and provide a description of our sample formation. We obtain our data from different sources to form a panel covering thirty-one provinces (including four municipalities which enjoy an administrative authority equivalent to those found in other provinces in China) for the time span from 1993 to 2006.[2]

Our main intention is to investigate the effects of different institutional factors on bank efficiencies at the regional level. Therefore, our dependent variables are banking profit efficiency and cost efficiency. Profit efficiency and cost efficiency are first estimated at the firm-year level, based on the stochastic efficiency frontier approach. More generally, cost and profit efficiency measure how well a bank is predicted to perform relative to a "best-practice" bank producing the same outputs under the same environmental conditions. That is, efficiency measures how close to the minimum cost or maximum profit a bank is, where the minimum and maximum are determined by best performers in the sample. We estimate efficiency levels by specifying the commonly used trans-log functional form for the cost and profit functions. For convenience, we show only the cost function:

$$\ln(C/w_3 z)_{it} = \alpha_0 + \sum_{j=1}^{4}\delta_j \ln(y_j/z)_{it} + \frac{1}{2}\sum_{j=1}^{4}\sum_{k=1}^{4}\delta_{jk}\ln(y_j/z)_{it}\ln(y_k/z)_{it} + \sum_{l=1}^{2}\beta_l \ln(w_l/w_3)_{it}$$
$$+ \frac{1}{2}\sum_{l=1}^{2}\sum_{m=1}^{2}\beta_{lm}\ln(w_l/w_3)_{it}\ln(w_m/w_3)_{it} + \sum_{j=1}^{4}\sum_{l=1}^{2}\theta_{jl}\ln(y_j/z)_{it}\ln(w_l/w_3)_{it}$$
$$+ \textit{ year dummies } + \ln\mu_{it} + \ln\nu_{it} \qquad \ldots(1)$$

where *i, t* index the bank and year, respectively, *k = 1,...4* index the four output variables, and $\delta_{jk} \equiv \delta_{kj}$. *C* represents the bank's total costs. While there is no consensus of the scope of the banking firm and no agreement on the explicit definition and measurement of banks' inputs and output, we use a modified version of the value-added approach following Berger and Humphrey (1992). In the value added approach, all items on both sides of the balance sheet may be identified as outputs or inputs depending on their contribution to the generation of bank value added. Accordingly, we specified four outputs (y): y_1 (total loans), y_2 (total deposits), y_3 (liquid assets), y_4 (other earning assets); three input prices (w): w_1 (price of funds, proxied by the ratio of interest expenses to total deposits), w_2 (price of fixed capital, proxied by the ratio of other operating expenses to fixed assets), w_3 (price of labor, proxied by the ratio of personnel expenses to total number of employees); and one fixed netput (z): total assets. The cost function is estimated using the $\ln\mu_{it} + \ln\nu_{it}$ as a composite error term, where the $\ln\mu_{it}$ term represents a bank's efficiency, and $\ln\nu_{it}$ is a random error that incorporates both measurement error and luck. In other words, a bank's cost efficiency score is determined by comparing its actual costs to the best-practice minimum costs of producing the same output under the same conditions using estimates of the efficiency factor $\ln\mu_{it}$, which is based on, in our case, the assumptions of half-normal distributions, and is disentangled from the estimated cost function residuals using maximum likelihood estimations. The normalization by a bank's total assets (*z*) reduces heteroskedasticity, and allows banks of any size to have comparable residual terms from which the efficiencies are calculated. The normalization by the last input price (w_3) ensures price homogeneity. The summary statistics of the output and input variables used in the bank efficiency estimations are presented in Table 1.

[Insert Table 1 here]

[2] The four municipalities are Beijing, Chongqing, Shanghai, and Tianjin.

The firm-year level of profit (cost) efficiency scores are then aggregated at the province-year level, with the weights equaling the proportion of each bank-year's loans to the total loans of all banks present in that province-year. More explicitly, we have

$$\text{Banking profit (cost) efficiency}_{\,j,\,t} = \sum_{i=1}^{n} g_{i,j,t}\mu_{i,t} \qquad \ldots(2)$$

$$\text{and} \quad g_{i,j,t} = \frac{L_{i,j,t}}{\sum_{i=1}^{n} L_{i,j,t}} \qquad \ldots(3)$$

In equations (2) and (3), j indexes the j^{th} province in our sample, and equals to 1, 2, …, 31. i indexes the i^{th} bank in our sample, and equals 1, 2, …, maximum number of banks in j^{th} province. t indexes year, and equals to 1993, 1994, …, 2006. $g_{i,\,j,\,t}$ indexes the weight of i^{th} bank in j^{th} province in year t. $L_{i,\,j,\,t}$ indexes the total loans provided by i^{th} bank to j^{th} province in year t. $\mu_{i,t}$ is the efficiency score estimated based on equation (1) for i^{th} bank in year t.

These province-year aggregated profit (cost) efficiency scores are then used as the dependent variable(s) in the OLS regressions and fixed-effects regressions that we present later on. For the independent variables, we have real GDP growth, ln (real GDP level), lagged, bank loans/GDP, equity and bond issuance/GDP, private sector, property rights, and rule of law. Below we provide more detailed descriptions of these variables.

We first include real GDP growth and lagged GDP level as the basic control variables in the regression analysis, given the natural link between broader economic development and banking performance discussed earlier. Real GDP growth is defined as the inflation-adjusted growth rate of annual GDP, and we use the lagged term of the natural log of real GDP (i.e., inflation-adjusted to the base year 1993) and label it as "ln (real GDP level), lagged".

We also include variables which control for the degree of regional financial development and financial depth; one is based on the size of the banking sector, the other on the size of the market-based finance sector. The size of the banking sector is measured by the ratio of regional banking loans to regional GDP (termed as "bank loans/GDP"), and regional banking loan data have been obtained from the annual issues of the Almanac of China's Finance and Banking (ACFB). The size of the market-based finance sector is measured by the ratio of equity and non-financial corporate debt (long-term and short-term) issuance to GDP (termed as "equity and bond issuance/GDP"). The issuance is for

firms incorporated in the respective province. Our equity issuance data are collected by summarizing the equity issuance data from both exchanges in China, based on the annual issues of the Statistics Yearbooks of the Shanghai Stock Exchange, and the Statistical Yearbooks of the Shenzhen Stock Exchange. Equity issuance is defined here as the gross proceeds raised by listed firms from issues. Data on corporate bond issuance have been collected from the ACFB and are available until 1999, and subsequently from the annual issues of the provincial yearbooks.

Our main variables in the regression analyses are the variables capturing the institutional environment. The first institutional aspect that we examine is the size of the private sector. We are interested in the link between the private sector and banking efficiency because our sample period from 1993 to 2006 represents an important privatization phase for China, and the influence of privatization on economic growth and the banking sector in transitional economies is not always obvious. We follow Cull and Xu (2005), and interpret the relative size of the private sector in the Chinese regional economy as a proxy for the extent of property rights protection. Thus, we expect this variable to be positively correlated with growth. The size of the private sector is measured by the ratio of regional private sector total fixed investment to regional total fixed investment. The data from China's private sector are from the China Economic Information Network Database and the China National Statistics Bureau.

Our second institutional variable is the awareness of and respect for property rights, particularly intellectual property. Our proxy for the awareness of property rights is the ratio of the number of domestic trademark applications to the number of firms. This ratio captures both awareness of property rights and the degree of development of secure property rights-associated institutions in each province. Our hypothesis is that more trademark applications reflect confidence in the preservation of property rights, and a desire to defend them. Data on domestic trademark applications have been collected from the annual issues of the Almanac of China's Property Rights, the Yearbook of China's Industrial and Commercial Administrative Statistics (which provides data starting in 1998), annual provincial yearbooks, a government-sponsored trademark website, and the online China Trademark database. Missing data are backcastusing the national data and the proportions of applications in the province to total applications in the country in 1998.

Our third institutional variable is the rule of law. Rule of law is very difficult to measure. We use the presence of legal professionals as an indicator of both the quality of

legal proceedings and the rule of law. Specifically, our measure for the rule of law is the number of lawyers per 10,000 people. Our justification for using this variable is that an increased presence of legal professionals in a province is an indicator of both the development of legal institutions and of the mechanisms for law enforcement. If more lawyers are at work, then there are greater efforts to promote public accountability and limit corruption. The data have been collected from the Statistics Yearbook of China's Legislation and the annual issues of the Statistics Yearbooks of each province, which provide data for 1990, 1995, 2000, 2001, and 2002. Additional information was collected from other web-based resources, such as the China Law on Lawyering (china-lawyering.com), the China Lawyers' Investigation web site (www.007cn.cn), and the China Lawyers' website (www.chineselawyer.com.cn). These websites provided additional data on the number of lawyers per province or city since the 1990s. Missing data have been interpolated based on nationwide growth in the number of lawyers. The population data have been obtained from the National Bureau of Statistics of China.

The summary statistics of the regional aggregated banking profit and cost efficiencies, and the independent variables used in the regression analyses, are presented in Table 2. This paper presents different profit and cost scores than other papers such as Berger, Hasan, Zhou (2008), and it is because this paper defines production function with three inputs instead of two inputs, and the third input we use is price of labor. However, despite the shifting of the mean and median of the profit and cost efficiency score that are estimated in this paper compared with other papers, we find that the results remain robust if the production function is defined alternatively with two input prices (price of funds, and price of fixed capital). Table 3 reports the correlation matrix of the independent variables.

[Insert Table 2 about here]

[Insert Table 3 about here]

4 Empirical results

In this section, we report our empirical evidence relating regional bank efficiency to institutional factors. We model regional bank efficiency as a function of different institutional factors, controlling for province-level economic conditions. More specifically, we intend to examine how the institutional environment may affect the profit efficiency and cost efficiency of the banking sector in that region.

4.1 Institutions and banking profit efficiency

In Table 4, we present empirical results relating banking profit efficiency to measures of institutional factors based on OLS regressions. Column 1 contains our baseline model with only controls for regional economic conditions. We find that provincial economic growth rates and the economic scale are positively correlated with bank profit efficiency. In columns 2-7, we enter different proxies for the institutional environment to test how regional institution development and the environment affect banking profit efficiency. The absolute values of t-statistics are reported in brackets in all the regression tables, and *, **, ***indicate significance at the 10%, 5%, and 1% levels, respectively.

[Insert Table 4 about here]

We now turn to the interpretation of different proxies for institutions and their effects on regional banking efficiency. As we discussed earlier, we use two measures to capture the financial institutions. The first measure, namely the ratio of bank loans to GDP, gauges the depth of the banking sector, which is significantly and positively associated with banking profit efficiency. Our second measure is based on non-banking sources of private sector financing, including equity financing and bond issuances. In contrast, the ratio of private sector financing to GDP possesses a negative relation with banking profit efficiency. The activities of the banking sector and capital markets in China appear to have opposite effects on the regional bank efficiency. However, these findings are not surprising. The positive sign associated with the depth of the banking sector points out that bank lending activities generally correlate with increased bank efficiency. In contrast, a region with more capital market activities (i.e., equity issuances and bond issuances) tends to have lower banking profit efficiency. Normally, there are very high thresholds for firms, be they state-owned or private, to participate in the equity markets or corporate bond markets. Without strong corporate governance mechanisms, firms tend to choose to finance their projects with less monitoring. This is the situation when firms choose arm's-length financing resources (i.e., corporate bonds). In the case of equity finance, minority shareholders are not able to effectively exert their power on corporate decision-making, and tend to be speculative. The consequence is that firms of good quality shy away from bank lending, leaving banks with relatively low-quality firms as their main customers. Therefore, the depth of the capital market is negatively associated with bank profit efficiency. Thakor (1998) develops a theoretical model to analyze the problems faced by emerging economies

in developing their financial systems. An important finding is that the relationship between banks and capital market is both competitive and complementary in a setting of transitional and state-dominated economies. Banks complement market in the sense that increasing banking efficiency, up to a point, actually leads borrowers accessing the market. Beyond that point, more borrowers will be competed away from the market by further improvement in bank efficiency. Nonetheless, he argues, it may not be possible to develop a good capital market in an economy that does not have good banks, and that the initial focus in developing a financial system should be on improving the efficiency of banks. In general, our results are consistent with the Thakor (1998) model.

With regard to other institutional factors, we find that a prosperous private sector is associated with better banking profit efficiency. This is generally consistent with the existing growth literature. Private firms contribute much to the economic growth, and have more incentives to keep up good relations with banks by not defaulting. In contrast, as indicated by the existing literature (Berglof and Roland, 1998), state-owned firms tend to have different incentives to maintain bank-firm relationship in a centrally planned economy because of soft budget constraints. Once the bank lending is directed and granted by the government, an SOE's repayment of the loan is not strictly enforced. In addition, it is well documented that small private firms are more flexible in choosing profitable projects and are able to capture entrepreneurial opportunities. For example, Frydman et al. (1999) compare the performance of privatized and state firms in the transition economies of Central Europe, and argue that privatization has different effects depending on the types of owners to whom it gives control. On the other hand, La Porta and Lopez De-Silanes (1999) examine privatized firms in Mexico and find that that privatization is followed by large improvements in performance. Our observation is consistent with the existing literature and reflects the increasing importance of private sector to the economic growth and banking efficiency in the transition from a centrally planned economy to a market-oriented economy in China.

As a next step, we use two variables, property rights awareness and rule of law, to capture the legal environment in which banks operate. Property rights awareness is measured by trademark applications, which are significantly and positively correlated with bank profit efficiency. There is much literature that confirms that well-defined property rights induce agents to exert their efforts. Consequently, creditors are better off in an environment where property rights are strictly enforced. The other measure is based on the

number of legal professionals. We attempt to capture a broad view of how legal institutions are enforced. However, this variable is negatively correlated with the profit efficiency of the banking sector. At first glance, we may wonder why strictly enforced legal institutions have a negative effect on regional banking profit efficiency. Taking into consideration the fact that most lending agreements between banks and SOEs are not strictly enforced in China, we predict that a strict legal environment should have a strong effect on the private sector. Most private firms are small and rely on relationship lending to access external financing, and have less access to capital markets. The literature in small business lending points out that "soft" information is the key feature in extending credit to small firms. Soft information is generated in daily relationships, and an important feature of soft information is that soft information is very difficult to pass on. Therefore, relationship banks need to invest a great amount of resources to collect proprietary information and tightly monitor their customers. It is plausible that the strict enforcement of legal institutions weakens such incentives and results in sub-optimal lending decisions with a higher default rate. Therefore, we observe a negative relation between the rule of law and banking profit efficiency.

In this section, we present our main empirical results on the impact of institutions on banking profit efficiency in the regional markets based on OLS regressions. Our proxies of institutional factors are measured at the province level and are unlikely to be affected by banking practices according to our construction of efficiency scores. However, if there are unobserved characteristics which are correlated with our variable of interest but omitted from the model, it would be inappropriate to draw any inference from the OLS results due to the biased estimation. Therefore, for each regression, we include province fixed effects to control for the micro-level unobservable time-invariant heterogeneity. In Table 5, we report our findings, relating banking profit efficiency to institutions based on fixed effects regressions.

[Insert Table 5 about here]

In general, controlling for unobservable time-invariant regional effects, we find consistent results as detailed above though the magnitudes of certain variables change slightly. The depth of banking activities measured by the ratio of bank loans to GDP is positively correlated with banking profit efficiency, while the ratio of equity and bond issuances to GDP is negatively associated with banking profit efficiency. The proportion of the private sector to the regional economy has a positive effect on banking profit efficien-

cy, which indicates the importance of the private sector for banks to generate profits. The awareness of property rights, an important feature of the institutional environment, is positively associated with regional banking profit efficiency, while rule of law reflects a negative effect on the profit efficiency of banking sectors.

4.2 Institutions and banking cost efficiency

Next, we investigate how institutions affect banking cost efficiency in different provinces. As detailed before, we obtain the banking cost efficiency on a relative base. We then regress the banking cost efficiency score on a set of variables capturing the regional institutional settings. Table 6 reports regression results relating banking cost efficiency to our measures of institutions through OLS. In column 1, we only enter basic controls for provincial economic conditions. We find the economic size of an individual province is negatively but insignificantly correlated with the banking sector's cost efficiency. Furthermore, the regional growth rate appears to have a negative and significant impact on banking cost efficiency. It is plausible that a fast-growing economy may attract more banking activities, which consequently increase the competition. With increased competition, borrowers' specific information becomes more dispersed because each bank only knows a small portion of the borrowers. Banks then incur higher costs in gathering information.

In Table 6, columns 2-7, we use different model specifications by adding different sets of variables to capture the regional institutional environment. The variable measuring the deepening of banking sectors is significantly and negatively correlated with banking cost efficiency. To put it another way, our finding indicates that a province with higher banking activity tends to have lower cost efficiency. It is documented that in China, banks do not compete by offering better services to attract low cost fund. Consequently, intensive competition increases the cost of non-interest expense. Therefore, we observe a negative relation between the ratio of bank loans to GDP and banking cost efficiency. Our other measure for the financial institutions, the activity of equity and bond capital markets, seems to have an insignificant effect on banking cost efficiency.

Turning to our measures of legal institutions, we find that more awareness of property rights positively affects the cost efficiency of of a banking sector. This finding indicates that in a province with better defined and awarded property rights, banks are better off in terms of better cost efficiency. Our other measure of the legal enforcement of

institutions, rule of law, is also positively associated with banking cost efficiency. Combined with the findings outlined in the previous section, it appears that rule of law tends to have different effects on profit efficiency and cost efficiency in the banking sector. As we have argued, banks operating in an environment with strict rule of law may have less incentive to spend resources in collecting proprietary information, which results in lower profit efficiency (Hauswald and Marquez, 2006). However, by reducing the investment in information collection, banks gain better cost efficiency.

[Insert Table 6 about here]

For the same reason as we discussed in the prior section, it is possible that our main explanatory variables may correlate with unobservable characteristics possessed by different provinces. We are able to control for this possibility by adding province fixed effects if those characteristics are time invariant. Table 7 presents our findings based on regression via fixed effects. As revealed in Table 7, our findings are pretty consistent, even after controlling for province fixed effects. Those results are qualitatively the same as reported in Table 6.

[Insert Table 7 about here]

In addition to the above tests, we perform several robustness checks. We collect more data on province-level economic activities (e.g., the number of firms and employment) and other demographic information. Adding these variables does not change our main findings. Therefore, for the sake of brevity, we report our empirical models as parsimoniously as possible.

5 Summary and conclusion

The efficiency of financial intermediation is essential for financial stability and sustainable economic growth. Prior studies on banking efficiency primarily focused on firm-level characteristics, while leaving the impact of institutions on banking efficiency largely unexplored. Meanwhile, important work such as LLSV (1997, 1998) has identified institutional factors, such as rule of law and property rights, as an integral part of a successful economy and financial system. In this paper, we attempt to fill the gap in the literature by empirically investigating the determinants of banking efficiency from an institutional perspective. The uneven distribution of institutional settings and non-synchronized economic develop-

ment across different Chinese regions provides an ideal laboratory for answering this question.

Based on a sample of 31 provinces in China during the period 1993-2006, we attempt to identify what institutional factors impact banking efficiency in China. We first measure banks' efficiency at a micro level using the conventional stochastic frontier approach, and then aggregate the results at the regional level. We then exploit the regional differences in the timing and extent of the development of financial, legal and political institutions to demonstrate the impact on the banking efficiency.

Our results show that different institutional factors tend to have different effects on the efficiency of the banking sector. Specifically, a higher degree of financial deepening proxied by bank loans to total GDP tends to relate to increased profit efficiency and decreased cost efficiency, while more financing in the private sector, proxied by equity and bond financing in the stock market, tends to relate to deceases in both profit and cost efficiency. The differences in the roles of banks and stock market financing in affecting banking efficiency, as we discussed earlier, may result from adverse selection and moral hazard problems in the financing decisions made by firms and the competition between banks and the capital market. Another important aspect of institutional development in China, proxied by the presence of the private sector, tends to relate positively and significantly to both the profit and cost efficiency of the country's regional banking. This is not surprising, because the growth in the private sector tends to decrease the dominance of the state-owned enterprises (SOEs) in the regional economy, which results in a higher percentage of loans extended to the private enterprises instead of SOEs, and therefore increases the performance of the banks in the region. The variable property rights, proxied by the number of trademark applications per firm, and representing the degree of awareness of property rights in the industry sector, is found to be positive and significantly correlated with both the profit and cost efficiency of the banks. On the other hand, rule of law, proxied by the number of lawyers per 10,000 people, is found to be negatively related to profit banking efficiency but positively and significantly related to cost banking efficiency. As we discussed earlier, strict rule of law may lead to fewer incentives for banks to spend resources in collecting proprietary information, which results in less profit efficiency (Hauswald and Marquez, 2006). However, by reducing the investment in information collection, banks gain better cost efficiency. In sum, our empirical results indicate that banks tend to operate more efficiently in those regions with higher presence of the private sector and more prop-

erty rights awareness, while the impact of financial deepening and rule of law on banking efficiency is less straightforward.

Though China has achieved remarkable economic growth throughout the last two decades, the large disparities among institutional foundations across its regions could impose a big challenge for the further success of the economy and the increased efficiency of the banking sector throughout the country. Therefore, our findings on the important role of institutions in banking efficiency could potentially yield implications for policy-makers in China, as well as in other transitional and emerging markets.

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Table 1 Summary statistics of variables used in stochastic efficiency frontier estimations

Table 1 presents the summary statistics of basic variables used in the profit and cost efficiency estimations. In the translog-based estimations of profit (cost) efficiency, the output variables considered are: y_1 (total loans), y_2 (total deposits), y_3 (liquid assets), and y_4 (other earning assets). The input variables are: w_1 (price of funds, proxied by the ratio of interest expenses to total deposits), w_2 (price of fixed capital, proxied by the ratio of other operating expenses to fixed assets), w_3 (price of labor, proxied by the ratio of personnel expenses to total number of employees). The outputs are normalized by total assets. All financial values are inflation-adjusted to the base year 1993.

	Obs	Mean	Median	Std. Dev.	Minimum	Maximum
Profit (Cost) (in billion US$)						
Total Profits	524	0.180	0.014	0.719	-0.080	5.784
Total Costs	524	0.956	0.082	2.539	0.000	21.200
Output Quantities (in billion US$)						
Total Loans (y_1)	524	23.614	1.517	62.360	0.000	426.000
Total Deposits (y_2)	524	37.323	2.451	106.520	0.000	791.000
Liquid Assets (y_3)	524	5.123	0.325	15.142	0.012	112.000
Other Earning Assets (y_4)	524	16.489	1.308	48.285	0.005	444.000
Input Prices						
Unit interest cost of deposits (w_1)	524	0.023	0.023	0.017	0.003	0.067
Unit price of physical inputs (w_2)	524	0.925	0.715	0.567	0.174	2.500
Unit price of labor (w_3)	524	14.135	14.244	2.524	0.720	21.105
Total Assets (in billon US$)	524	42.520	3.234	124.250	0.033	880.000

Table 2 Summary statistics of variables used in the regression analyses

Table 2 presents the summary statistics of the variables that are used in the regression analyses. Profit efficiency and cost efficiency are first estimated at the firm-year level, based on the stochastic efficiency frontier approach, using the translog-based profit and cost function with inputs and outputs specified in Table 1. The firm-year level of profit (cost) efficiency scores are then aggregated at the province-year level, with the weights equaling to the proportion of each bank-year's total loans to the total loans present in that province-year. These province-year aggregated profit (cost) efficiency scores are then used as the dependent variable(s) in the OLS regressions and fixed-effects regressions that we present later on. For the independent variables, we have: real GDP growth (defined as the inflation-adjusted growth rate of annual GDP), ln(real GDP level), lagged (defined as the natural log of real initial (or lagged) GDP), bank loans/GDP (defined as the ratio of total bank loans to GDP), equity and bond issuance/GDP (defined as the ratio of equity and non-financial corporate debt (long-term and short-term) issuance to GDP, private sector (defined as the ratio of private sector total fixed investment to overall total fixed investment), property rights (defined as the ratio of the number of domestic trademark applications to the number of firms), and rule of law (defined as the number of lawyers per 10,000 people). All the independent variables are measured at the province-year level.

	Obs	Mean	Median	Std. Dev.	Minimum	Maximum
Stochastic Efficiency Frontier						
Profit efficiency	432	0.833	0.817	0.041	0.782	0.921
Cost efficiency	432	0.471	0.490	0.057	0.314	0.574
Explanatory Variables						
Real GDP growth	430	0.111	0.112	0.039	-0.020	0.224
ln(real GDP level), lagged	430	25.187	25.161	1.356	21.292	28.379
Bank loans/GDP	431	0.920	0.860	0.371	0.377	2.925
Equity and bond issuance/GDP	431	0.010	0.006	0.016	0.000	0.211
Private sector	430	0.449	0.471	0.146	0.025	0.703
Property rights	431	0.896	0.663	0.869	0.055	5.013
Rule of law	430	0.952	0.745	1.005	0.147	7.446

Table 3 Correlation Matrix

Table 3 presents the correlation matrix of the independent variables in the regression analyses. The definitions of the variables are the same as in Table 2.

		1	2	3	4	5	6	7
1	Real GDP growth	1.000						
2	ln(real GDP level), lagged	0.411	1.000					
3	Bank loans/GDP	0.007	-0.152	1.000				
4	Equity and bond issuance/GDP	0.026	-0.117	0.293	1.000			
5	Private sector	0.349	0.740	-0.120	-0.050	1.000		
6	Property rights	0.283	0.478	0.463	0.075	0.486	1.000	
7	Rule of law	0.125	0.182	0.738	0.301	0.225	0.569	1.000

Table 4 Regression relating provincial banking profit efficiency to institutions: OLS

Table 4 presents the ordinary least squared (OLS) regressions of banking profit efficiencies on the institutional variables and control variables. The definitions of the variables are the same as in Table 2. Absolute values of t statistics are presented in brackets. *, **, *** represent a significance level of 10%, 5%, and 1% respectively.

Independent variables	**Dependent variable: banking profit efficiency**						
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Constant	0.553***	0.501***	0.513***	0.652***	0.657***	0.436***	0.599***
	[15.80]	[14.12]	[14.64]	[16.14]	[14.75]	[11.05]	[13.44]
Real GDP growth	0.193***	0.173***	0.184***	0.154***	0.166***	0.179***	0.154***
	[3.83]	[3.50]	[3.79]	[3.42]	[3.63]	[3.76]	[3.49]
ln(real GDP level), lagged	0.010***	0.012***	0.011***	0.007***	0.006***	0.014***	0.008***
	[7.02]	[7.98]	[7.71]	[3.62]	[3.32]	[8.80]	[4.17]
Bank loans/GDP		0.024***	0.030***		0.001	0.053***	0.027***
		[5.06]	[6.06]		[0.02]	[7.01]	[3.55]
Equity and bond issuance/GDP			-0.434***		-0.384***	-0.356***	-0.291***
			[3.98]		[3.76]	[3.27]	[2.89]
Private sector				0.040**	0.040**		0.022
				[2.43]	[2.32]		[1.30]
Property rights				0.028***	0.022***		0.024***
				[10.96]	[7.99]		[8.68]
Rule of law				-0.009***		-0.011***	-0.014***
				[4.79]		[3.99]	[5.24]
Observations	428	428	428	428	428	428	428
F-statistic	52.68	45.68	39.42	51.40	40.75	35.82	41.05
R-square	0.20	0.24	0.27	0.38	0.37	0.30	0.41
Adjusted R-square	0.19	0.24	0.26	0.37	0.36	0.29	0.40

Table 5 Regressions relating provincial banking profit efficiency to institutions: fixed effects

Table 5 presents the province fixed-effects regressions of banking profit efficiencies on the institutional variables and control variables. The definitions of the variables are the same as in Table 2. Absolute values of t statistics are presented in brackets. *, **, *** represent significance a level of 10%, 5%, and 1% respectively.

Independent variables	**Dependent variable: banking profit efficiency**						
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Constant	0.042	0.058	0.071	0.440***	0.471***	0.077	0.468***
	[0.92]	[1.25]	[1.50]	[7.49]	[7.76]	[1.58]	[7.72]
Real GDP growth	0.052*	0.051*	0.056*	0.027*	0.041**	0.058	0.036*
	[1.84]	[1.82]	[1.92]	[1.65]	[1.99]	[1.27]	[1.86]
Ln(real GDP level), lagged	0.031***	0.030***	0.029***	0.014***	0.013***	0.029***	0.013***
	[16.65]	[14.97]	[14.30]	[5.50]	[5.22]	[14.16]	[5.14]
Bank loans/GDP		0.014*	0.015*		0.028***	0.008	0.012
		[1.78]	[1.71]		[2.94]	[0.48]	[0.82]
Equity and bond issuance/GDP			-0.125*		-0.123*	-0.114**	-0.147***
			[1.78]		[1.77]	[2.05]	[2.50]
Private sector				0.066***	0.057**		0.060**
				[2.73]	[2.34]		[2.46]
Property rights				0.027***	0.028***		0.029***
				[7.29]	[7.37]		[7.48]
Rule of law				-0.012***		-0.004	-0.008
				[3.01]		[0.54]	[1.27]
Observations	428	428	428	428	428	428	428
Number of group	31	31	31	31	31	31	31
F-statistic	186.26	125.48	94.56	109.68	91.94	75.56	79.16
R-square	0.49	0.49	0.49	0.58	0.59	0.49	0.59
Adjusted R-square	0.44	0.45	0.45	0.55	0.55	0.45	0.55

Table 6 Regressions relating provincial banking cost efficiency to institutions: OLS

Table 6 presents the ordinary least squared (OLS) regressions of banking cost efficiencies on the institutional variables and control variables. The definitions of the variables are the same as in Table 2. Absolute values of t statistics are presented in brackets. *, **, *** represent a significance level of 10%, 5%, and 1% respectively.

Independent variable	**Dependent variable: Banking cost efficiency**						
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Constant	0.734***	0.770***	0.764***	0.608***	0.612***	0.838***	0.671***
	[14.09]	[14.23]	[14.09]	[9.18]	[8.40]	[13.56]	[9.02]
Real GDP growth	-0.086	-0.072	-0.077	-0.051	-0.057	-0.073	-0.046
	[1.15]	[0.96]	[1.03]	[0.69]	[0.76]	[0.98]	[0.62]
ln(real GDP level), lagged	-0.010***	-0.011***	-0.011***	-0.005	-0.005	-0.013***	-0.006**
	[4.61]	[4.96]	[4.83]	[1.57]	[1.54]	[5.43]	[2.02]
Bank loans/GDP		-0.017**	-0.019**		0.001	-0.041***	-0.026**
		[2.30]	[2.56]		[0.14]	[3.53]	[2.05]
Equity and bond issuance/GDP			0.210		0.187	0.136	0.092
			[1.25]		[1.12]	[0.79]	[0.55]
Private sector				0.006	0.005		0.023
				[0.21]	[0.16]		[0.80]
Property rights				0.021***	0.016***		0.017***
				[5.07]	[3.49]		[3.81]
Rule of law				0.009***		0.011**	0.014***
				[2.71]		[2.44]	[3.20]
Observations	428	428	428	428	428	428	428
F-statistic	16.47	12.86	10.05	12.36	9.18	9.32	9.51
R-square	0.07	0.08	0.09	0.13	0.12	0.10	0.14
Adjusted R-square	0.07	0.08	0.08	0.12	0.10	0.09	0.12

Table 7 Regressions relating provincial banking cost efficiency to institutions: fixed effects

Table 7 presents the province fixed-effects regressions of banking cost efficiencies on the institutional variables and control variables. The definitions of the variables are the same as in Table 2. Absolute values of t statistics are presented in brackets. *, **, *** represent a significance level of 10%, 5%, and 1% respectively.

Independent variables	**Dependent variable: banking cost efficiency**						
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Constant	0.997***	0.963***	0.960***	0.529***	0.530***	0.972***	0.536***
	[12.29]	[11.62]	[11.23]	[4.71]	[4.54]	[11.07]	[4.60]
Real GDP growth	-0.060	-0.058	-0.059	-0.031	-0.042	-0.054	-0.028
	[0.73]	[0.71]	[0.72]	[0.39]	[0.52]	[0.66]	[0.35]
ln(real GDP level), lagged	-0.021***	-0.018***	-0.018***	-0.001	-0.001	-0.018***	-0.001
	[6.13]	[5.06]	[4.89]	[0.04]	[0.09]	[4.92]	[0.01]
Bank loans/GDP		-0.029*	-0.030*		0.017	-0.044	-0.022
		[1.82]	[1.82]		[0.92]	[1.49]	[0.76]
Equity and bond issuance/GDP			0.027		0.021	0.049	0.082
			[0.14]		[0.11]	[0.25]	[0.43]
Private sector				0.077*	0.071		0.079*
				[1.66]	[1.52]		[1.69]
Property rights				0.032***	0.030***		0.031***
				[4.46]	[4.03]		[4.21]
Rule of law				0.013*		0.007	0.021*
				[1.77]		[0.59]	[1.70]
Observations	428	428	428	428	428	428	428
Number of group	31	31	31	31	31	31	31
F-statistic	26.53	18.90	14.14	18.37	14.81	11.37	13.17
R-square	0.12	0.13	0.13	0.19	0.19	0.13	0.19
Adjusted R-square	0.05	0.05	0.05	0.12	0.11	0.05	0.11

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